DEVELOPMENT OF MEASURING TEMPERATURE CHANGE FOR WATER QUALITY INDEX IN UMP LAKE, PEKAN CAMPUS.

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I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

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ABSTRACT

This project proposed a development of temperature changing measuring system for water quality index in UMP Lake, Pekan Campus. Temperature is one of nine critical water qualities and environmental parameter because it governs the kinds and types of aquatic life, regulates the maximum dissolved oxygen. With respect to chemical and biological reactions, when the water temperature is increased, the rate of chemical and metabolic reactions will also increase. This project will use Graphic User Interface (GUI) of Visual Basic, the software will be the data storage which save all the data measured by the temperature sensor. The temperature sensor will send a feedback through ZigBee Compatible Wireless device. The current technology in adopting wireless terminal technology for instrumentation directly leads to efficient process. In a warm water streams, the temperatures should not exceed 89 degrees Fahrenheit. Cold water streams should not exceed 68 degrees Fahrenheit. The expected result is the sensor will monitor the temperature in UMP Lake and send the data to the software. If the sensor detect the water temperatures exceed 89 degrees Fahrenheit, or 68 degrees Fahrenheit in cold water stream, it will send a warning signal to the computer through the wireless device.

ABSTRAK

Projek ini mencadangkan satu perkembangan/pembaharuan mengenai kaedah penyukatan perubahan suhu untuk kualiti indeks air di Tasik UMP, Kampus Pekan. Suhu merupakan salah satu daripada sembilan kualiti air yang kritikal dan merupakan parameter alam sekitar/ sekeliling kerana ia mengawal jenis-jenis hidupan akuatik, di mana ia turut mengawal keterlarutan kuantiti oksigen yang maksimum di dalam air. Berdasarkan tindak balas kimia dan biologi, apabila suhu air dinaikkan, kadar tindak balas kimia dan metabolisme juga turut meningkan. Projek ini akan menggunakan Graphic User Interface (GUI) daripada Visual Basic, di mana perisian komputer ini akan menyimpan kesemua data yang diukur melalui pengesan suhu. Pengesan suhu tersebut akan menghantar maklum balas melalui alat ZigBee Compatible Wireless. Teknologi semasa dalam mengadaptasi teknologi peralatan tanpa wayar untuk peralatan sememangnya membawa ke arah proses yang lebih berkesan. Di dalam aliran air sejuk, suhu tersebut sepatutnya tidak melebihi 89 darjah Fahrenheit. Keputusan yang diramal ialah pengesan tersebut akan memantau suhu di Tasik UMP dan menghantar data kepada perisian computer tersebut. Jika pengesan tersebut mengesan suhu air melebihi 89 darjah Fahrenheit atau 68 darjah Fahrenheit pada aliran air sejuk, ia akan menghantar isyarat amaran pada komputer melalui alat tanpa wayar tersebut.

LIST OF FIGURES

LIST OF FIGURES

LIST OF SYMBOLS

mA	Miliampere
mV	MiliVolts
ms	Miliseconds
°C	Degree Celcius
V	Volts

LIST OF ABBREVIATIONS

AD	Analog to Digital
ADC	Analog to Digital Converter
ANN	Artificial Neural Network
CD	Compact Disc
CDMA	Code Division Multiple Access
COM	Component Object Model
FSK	Frequency Shift Keying
GSM	Global System Communication for Mobile Phone
GPRS	General Packet Radio Service
HART	Highway Addressable Remote Transducer
IDE	Integrated development environment
IEEE	Institute of Electrical and Electronics Engineers
I\O	Input Output
LCD	Liquid Crystal Display
OEM	Original Equipment Manufacturer
PIC	Peripheral Interface Controller
PC	Personal Computer
RF	Radio frequency
RS	Radio Signal
UMP	Universiti Malaysia Pahang
USB	Universal Serial Bus
VB	Visual Basic
VPN	Virtual Private Network
WHAN	wireless home area networks
WLAN	Wireless local area network
WPAN	Wireless personal area networking
WQI	Water Quality Index
WSN	Wireless System Network

LIST OF TABLES

LIST OF APPENDICES

TABLE OF CONTENT

TABLE OF CONTENT

TABLE OF CONTENT

CHAPTER 1

INTRODUCTION

1.1 Project Background

Water quality measurements fall into three broad categories which is physical characteristic, chemical characteristic and biological characteristic. Water temperature measurement is categories under physical characteristic. Temperature is one of the critical water quality and environmental parameter because it governs the kinds and types of aquatic life, regulates the maximum dissolved oxygen concentration of the water, rate of photosynthesis of plants, metabolic rates of animals, the sensitivity of organisms to toxic wastes, parasites and diseases, and influences the rate of chemical and biological reactions.[3] With respect to chemical and biological reactions, when the water temperature is increased, the rate of chemical and metabolic reactions will also increase.[1] Thermal pollution is an increase in water temperature caused by adding relatively warm water to cooler stream water. The cutting down of trees that shade a lake will expose it to sunlight and increase temperature. Measurement of temperature change can help detect sources of thermal pollution and suggest the size of habitat for organisms that are more sensitive to temperature variation.

1.2 Introduction to the Project

In this project, wireless technology will be use to transfer the data taken from the sensor to the computer. It is an improvement from the previous wiring technology which is expensive due to the wiring installation and maintenance. Wireless technology also allow otherwise impossible sensor applications, such as monitoring dangerous, hazardous, unwired or remote areas and locations. Wireless technologies have been under rapid development during recent years. Types of wireless technologies being developed range from simple infrared light for short-range, point-to-point communications, to wireless personal area network (WPAN) for short range, point-to multi-point communications, such as Bluetooth and ZigBee, to mid-range, multi-hop wireless local area network (WLAN), to long-distance cellular phone systems, such as GSM/GPRS and CDMA.[4]

Hence, this project is an improvement for the wiring water temperature measuring system by using wireless technology and it will also calculate the water quality index (WQI). WQI is a 100 point scale that summarizes results from a total of nine different measurements when complete (refer to table 1). The point is calculated from the change of water temperature. Finally, if the sensor detected the water temperatures exceed 89 degrees Fahrenheit, or 68 degrees Fahrenheit in cold water stream, it will send a warning signal to the computer through the wireless device.

This project will be using the Visual Basic software to interface the ZigBee receiver and the computer to display the temperature data. Visual Basic (VB) is also considered a relatively easy to learn and use programming language, because of its graphical development features and BASIC heritage.[7] Visual Basic is user friendly software and it also has simple applications. Hence, Visual Basic is suitable software to be used for this project because this software is for a beginner programmer.

Table 1 : Water Quality Index (WQI) Legend

The value different	QUALITY
0	Excellence
5	Good
10	Medium
20	Bad
20 and above	Very Bad

1.3 Problem Statement

Problems of water quality have been a factor in determining human welfare. At present, continuous monitoring of drinking water and wastewater quality at most treatment plants is applied in Europe, North America and Japan. In China, online monitoring installations have been constructed for several large rivers, such as the Huanghe River and the Huaihe River, to provide real-time information to support environmental protection decision-makers.[2] There are nine factors in water quality index measurement but this project only focus on the temperature measurement. Often summer heat can cause fish kills in ponds because high temperatures reduce available oxygen in the water.[1] Therefore this system can avoid this problem occur in our country by measuring the water temperature and calculate the changes in temperature to get the water quality index.

Due to the rapid developments in the miniaturization of electronic devices and wireless communication technology have led to the emergence of WSN.[6] The wireless technology are more practical that the wiring technology. The previous technology, they using wire as a medium to send a data or information which is expensive due to the maintenance and also wiring installation.

Nowadays, it is also a difficult job to put the sensor and collect the data near the lake during bad weather or monitoring dangerous, hazardous, unwired or remote areas and locations. By implement the wireless instrument in this system, it allows impossible sensor applications.

1.4 Objectives

The main objectives of this project are design a wireless temperature measuring system for water quality index at UMP lake, Pekan. While measuring the water temperature, the system will calculate the water quality index base on temperature. The specific objectives of this project are listed below:

i. Develop a wireless temperature measurement system in UMP Lake.
ii. Develop software for the temperature measurement system and also calculate the WQI for the lake.
iii. Measure and monitoring the temperature from UMP Lake using wireless network system ZigBee.

1.5 Scope of Project

Scope of this project is to determine the lake temperature using the temperature sensor and display the data in the computer. The data will be display at the computer screen and the system will calculate the lake water WQI if there is a change in the water temperature. It will also give an alert if the water temperature exceed to the dangerous level and also if the water quality index give a bad feedback water quality.

This system is using the wireless instruments as the interface between the hardware and the software. Hence, by using the wireless technology such as ZigBee for this project, it can reduce the cost taken when developing this project. This method will be used so that the data can be taken at certain or dangerous place without risking our safety and make our work more easy than before.

CHAPTER 2

LITERATURE REVIEW

This chapter focused on the literature review for main component in this project. The main component is described based on the findings from journal or articles during the completion of this project.

2.1 XBee-PRO® OEM RF Modules

ZigBee is a new type of WPAN based on the IEEE 802.15.4-2003 standard for wireless home area networks (WHANs) which widely used by industry nowadays. Zigbee wireless mesh technology has been developed to address sensor and control applications with its promise of robust and reliable, self-configuring and self-healing networks that provide a simple, cost-effective and battery-efficient approach to adding wireless to any application, mobile, fixed or portable. ZigBee devices bring simple, effective wireless connectivity to low-rate sensors and control devices at an effective cost. ZigBee is widely use nowadays in industry for monitoring, data collection, surveillance and medical telemetry.

This new wireless technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPAN, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, low power usage, and secure networking. It is also easy to deploy, low cost, and can be used globally. The low cost allows the technology to be widely deployed in wireless control and monitoring applications such as for this project which is to monitor the water temperature. The low power usage allows longer life with smaller batteries and it also have a high connection range.

XBee-PRO® OEM RF Modules (figure 2.1) will be used as the wireless network system in this project. It is one type of the ZigBee which were engineered to meet IEEE 802.15.4 standards and support the unique needs of low-cost, low-power wireless sensor networks. XBee-PRO® OEM RF Modules are the most advanced ZigBee modules available in the XBee footprint and are ideal for deployment in ZigBee networks.[9]

The modules require minimal power and provide reliable delivery of data between devices. The modules operate within the ISM 2.4 GHz frequency band and are pin-for-pin compatible with each other. With advanced mesh networking functionality, XBee and XBee-PRO modules improve data traffic management, allow for greater node density, and provide OEMs with the ability to change firmware remotely with over-the-air updates.[9]

Figure 2.1: XBee-PRO® OEM RF Modules

The XBee-PRO RF Module were designed to mount into a receptacle (socket) and therefore does not require any soldering when mounting it to a board as it shown in figure 2.2. The XBee Development Kits contain RS-232 and USB interface boards which use two 20-pin receptacles to receive modules. The mechanical and ZigBee-mesh drawing of XBee-PRO RF Module are shown below in figure 2.3 and figure 2.4 respectively.

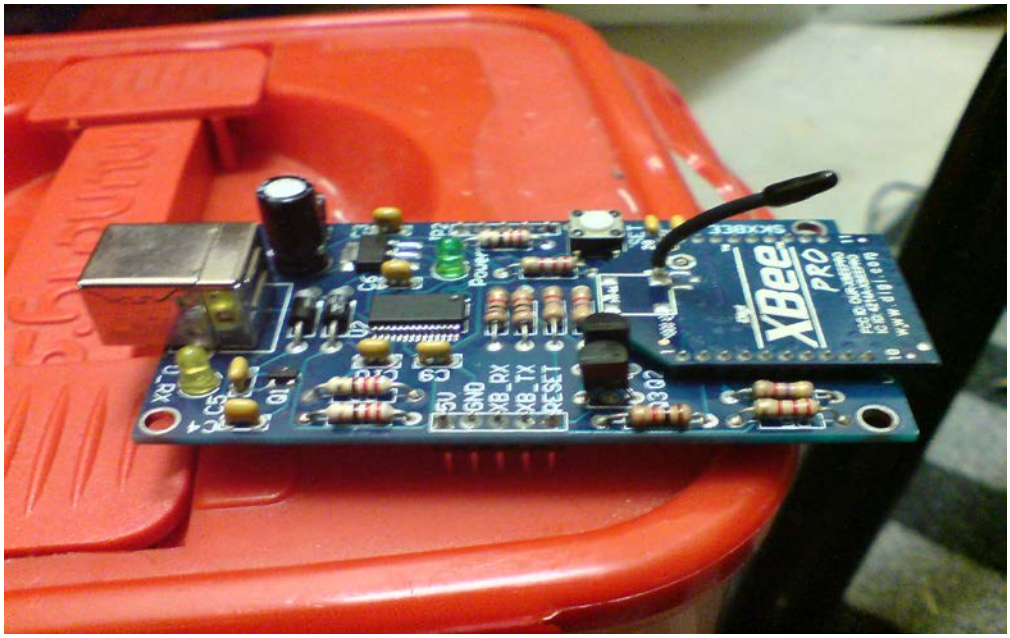

Figure 2.2: A receptacle (socket) for XBee-PRO RF Module

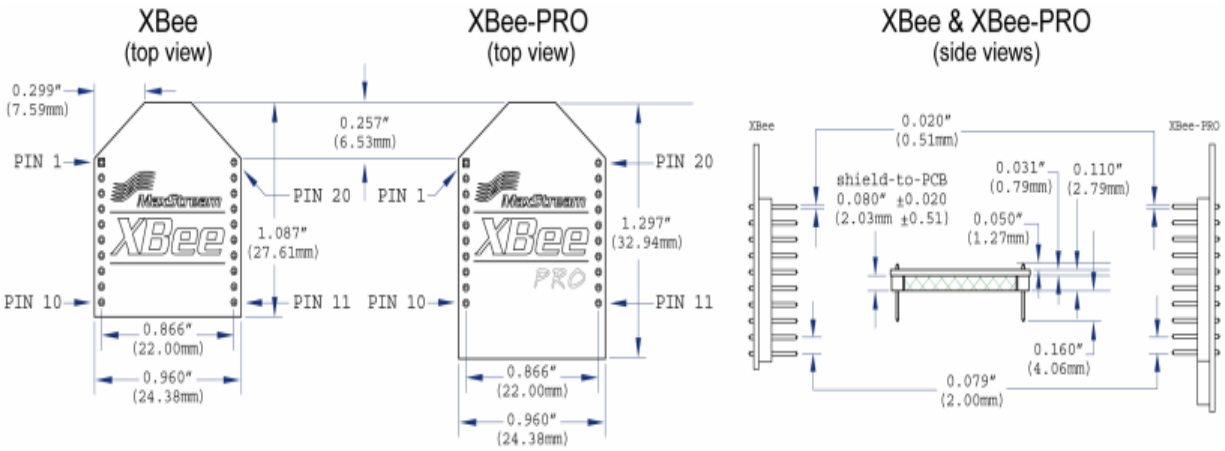

Figure 2.3: The mechanical drawing of XBee-PRO RF Module

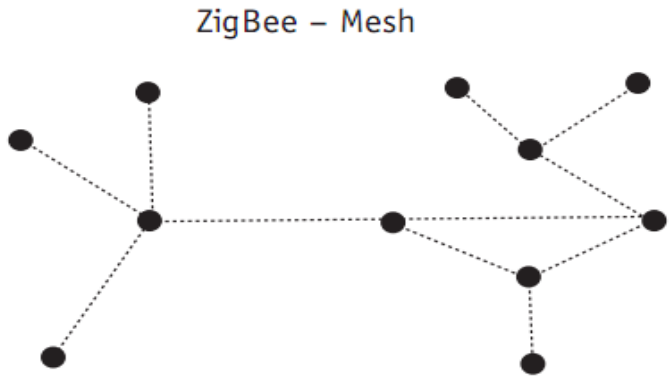

Figure 2.4: ZigBee-mesh

2.2 Thermocouple Type K

Thermocouple is a type of temperature sensor which widely used for measurement, control and also to convert heat to electrical power. It is a device which has a junction between two different metals that produces a voltage related to a temperature difference. They are cheap, interchangeable, have standard connectors and can measure a wide range of temperatures. Thermocouples are widely used in science and industry applications include temperature measurement for kilns, gas turbine exhaust, diesel engines, and other industrial processes. The main limitation is accuracy, system errors of less than 1°C can be difficult to achieve.

Thermocouples for practical measurement of temperature are junctions of specific alloys which have a predictable and repeatable relationship between temperature and voltage. Different alloys are used for different temperature ranges. Properties such as resistance to corrosion may also be important when choosing a type of thermocouple. Where the measurement point is far from the measuring instrument, the intermediate connection can be made by extension wires which are less costly than the materials used to make the sensor. Thermocouples are usually standardized against a reference temperature of 0 degrees Celsius practical instruments use electronic methods of cold-junction compensation to adjust for varying temperature at the instrument terminals. Electronic instruments can also compensate for the varying characteristics of the thermocouple, and so improve the precision and accuracy of measurements.[7]